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Aquatic Ecosystem Classification (AEC): Client Needs Survey Response

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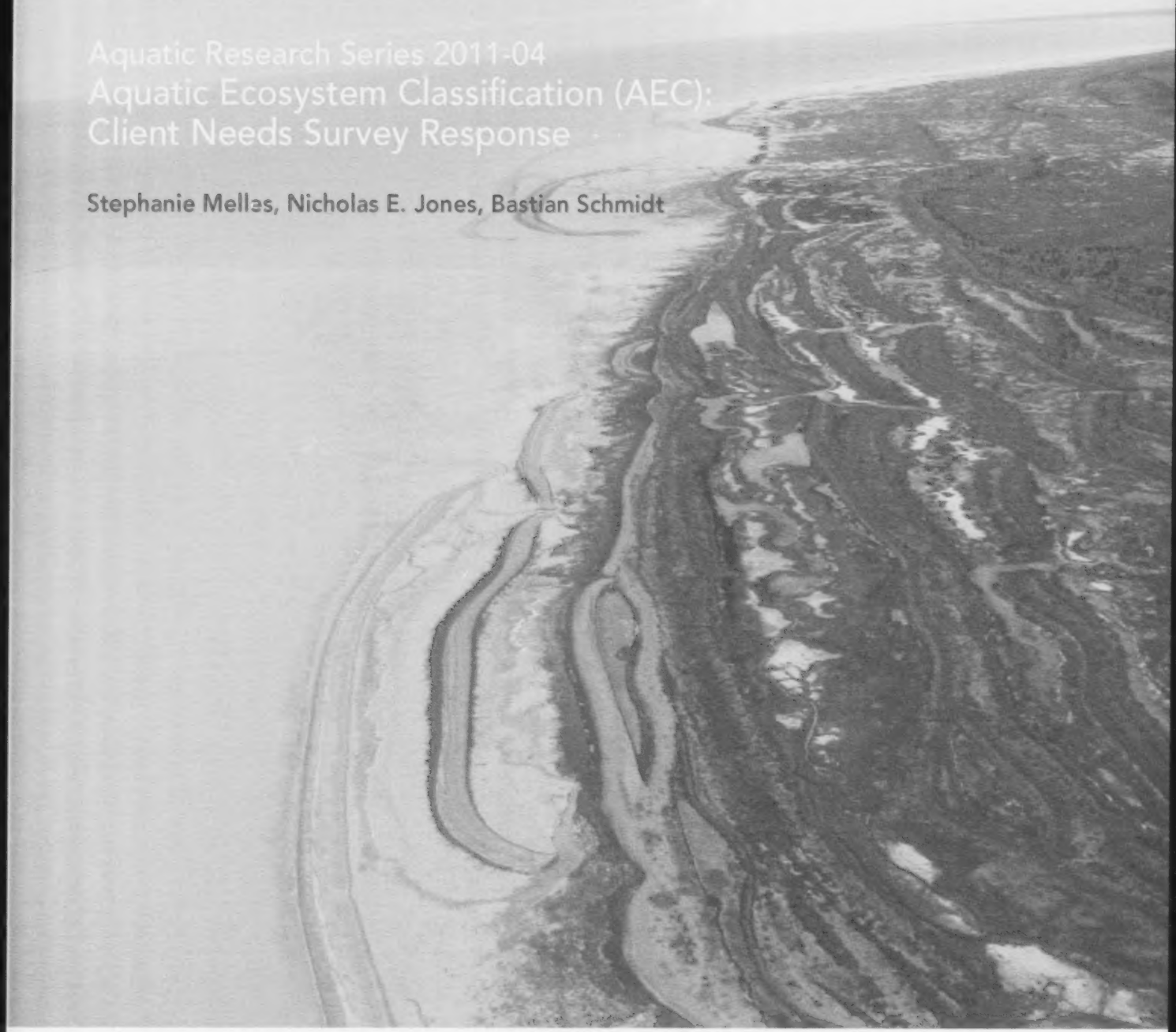

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Aquatic Ecosystem Classification (AEC): Client Needs Survey Response

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Abstract

Aquatic Research and Development Section circulated a client needs survey on Aquatic Ecosystem Classification (AEC) in April 2011 to ascertain how various branches and sections within the Ministry of Natural Resources could use an Aquatic Ecosystem Classification. A provincial AEC will identify unique aquatic ecosystems in Ontario to represent the full spectrum of diversity in our freshwater systems (watersheds, lakes, rivers, shorelines, wetlands, and streams). Objectives of the survey were to: raise awareness; gather an aquatic classification science team; and document the needs of our internal MNR clients. A section level response was requested and 17 sections from four divisions completed the survey. Comments were received from an additional five sections. The vast majority of respondents confirmed the utility of a province-wide aquatic classification in relation to a wide variety of user-needs including: surveying and inventory (i.e., monitoring) of aquatic features and biota; identification of sites that may support species at risk; and strategic planning for resource use and development (e.g., renewable energy projects). Respondents identified a number of provincial and federal acts, policies, directions, and guidelines that would be supported by an aquatic classification (e.g., Ontario's Biodiversity Strategy, Endangered Species Act, the Far North Act, Fisheries Act, and Watershed-based Fisheries Management Planning Guidelines). We conclude that Ontario needs an Aquatic Ecosystem Classification - now more than ever before - to support community-based land-use planning in the Far North, and to support species at risk and landscape-level, watershed-based planning in southern Ontario.

Résumé

La section de recherche-développement en matière de pêche a diffusé en avril 2011 un sondage sur les besoins des clients portant sur la classification des écosystèmes aquatiques (CEA) pour déterminer comment les différents directions et sections du ministère des Richesses naturelles (MRN) pourraient tirer profit d'une telle classification. Une CEA à l'échelle provinciale permettra d'identifier les écosystèmes aquatiques uniques en Ontario et de faire ressortir la grande diversité de nos écosystèmes d'eau douce (bassins versants, lacs, rivières, rivages, terres humides et cours d'eau). Les objectifs de ce sondage sont les suivants : sensibiliser, réunir une équipe scientifique chargée de la classification des écosystèmes aquatiques et documenter les besoins des clients internes du MRN. Chaque section avait à répondre au sondage et 17 sections de quatre divisions l'on fait. Cinq autres sections ont envoyé leurs commentaires. La vaste majorité des répondants ont confirmé l'intérêt pour les utilisateurs d'une classification des écosystèmes aquatiques à l'échelle provinciale qui répondrait à plusieurs de leurs besoins tels que le recensement et l'inventaire (p. ex., la surveillance) des attraits et du biote aquatiques, l'identification de sites pouvant abriter les espèces en voie de disparition et la planification stratégique de l'utilisation et du développement des ressources (p. ex., des projets d'énergie renouvelable). Les répondants ont identifié un certain nombre de lois, de politiques, d'orientations et de directives provinciales et fédérales qui profiteraient d'une classification des écosystèmes aquatiques (p. ex., la Stratégie de la biodiversité de l'Ontario, la Loi de 2007 sur les espèces en voie de disparition, la Loi de 2010 sur le Grand Nord, la Loi sur les Pêches et les lignes directrices du plan de gestion des pêches au niveau des bassins versants). Nous concluons que l'Ontario a besoin – aujourd'hui plus que jamais – d'une CEA pour soutenir les initiatives communautaires d'aménagement du territoire dans le Grand Nord, et pour soutenir les espèces en voie de disparition et le plan de gestion des terres au niveau des paysages et des bassins versants dans le sud de l'Ontario.

Introduction

Aquatic Research and Development Section (ARDS) circulated a 'Client Needs Assessment' on Aquatic Ecosystem Classification (AEC) in April, 2011 to ascertain how various branches and sections within the Ministry of Natural Resources could use an aquatic ecosystem classification. A factsheet on aquatic ecosystem classification was circulated along with the survey, and details of the proposed classification were presented at a *Food for Thought* seminar in Peterborough on March 28th, 2011. Actual survey and the related informational material circulated can be found in Appendix 1. Objectives of the survey were to:

1. Raise awareness about the project
2. Gather a science team to provide ARDS with input in the development of an AEC
3. Document the needs of interested MNR branches and sections

The following sections of this report provide a summary of the results.

Section 1: Organizational information

The client needs survey was circulated to 26 sections within 14 branches of 4 OMNR divisions including Regional Operations (ROD), Provincial Services (PSD), Policy (PD), and Science & Information Resources Divisions (SIRD). A list of these sections can be found in Appendix 2. A section level response was requested and 17 sections completed the survey (Fig 1). Five additional sections submitted email comments separately and indicated their interest in aquatic classification for Ontario.

1. ARDB/ARDS, proponents of the needs assessment (incl. in Fig. 1),
2. Far North Branch, Far North Planning Section (main funding source to date),
3. Integration Branch, Land & Water Services Section,
4. Biodiversity Branch, Biodiversity Policy and Program Development,
5. Geographic Information Branch, Water Resources Information Program.

Representation from various sections in the Ministry for the needs assessment was fairly broad. Figure 1 depicts a pie chart with the outer ring (or *crust*) depicting the four out of five divisions represented in the survey: the size of the pieces represents the number of individuals that participated by section (*colour shades*) and branch (*black lines*, Fig. 1). The majority of participants were in either Policy Division or Science & Information Resources Division (Fig. 1).

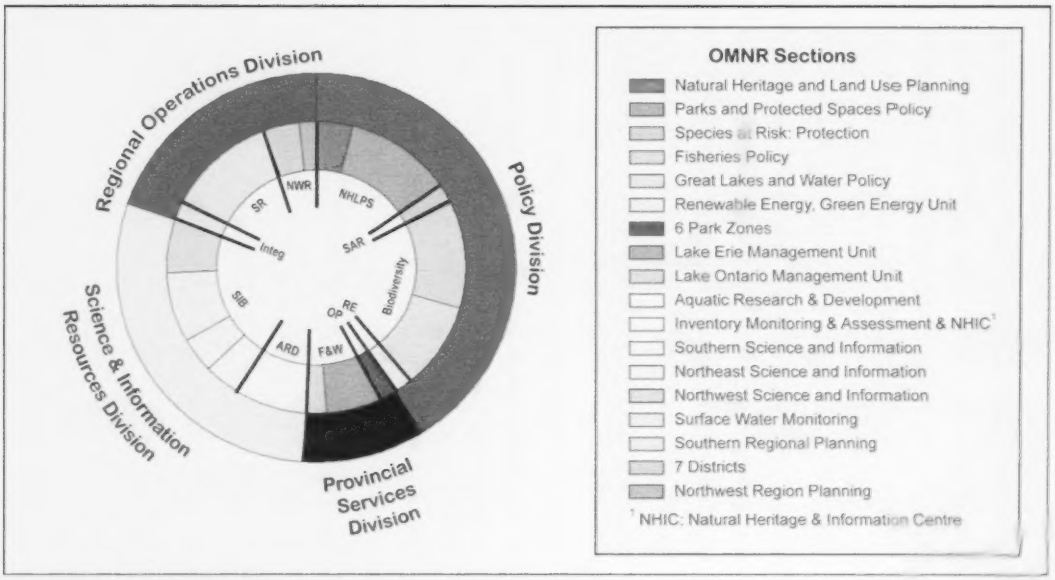

Figure 1. *Break down of responses to OMNR client needs survey for aquatic ecosystem classification by division, branch, and section. Size of the pie is proportional to the number of people that contributed to filling out the survey within a section. Branch acronyms are as follows: NHLPS: Natural Heritage, Lands and Protected Spaces; SAR: Species at Risk; Biodiversity; RE: Renewable Energy; OP: Ontario Parks; F&W: Fish & Wildlife Services; ARD: Applied Research and Development; SIB: Science & Information Branch; Integ: Integration; SR: Southern Region; NWR: Northwest Region.*

Most groups provided a section-level response (Fig. 2). If surveys were completed by only a single representative of their entire section, these surveys were given equal weight with other section-level responses. Though this gives undue weight to the responses of some individuals, we wanted to ensure that a breadth of needs and requirements throughout the OMNR was captured.

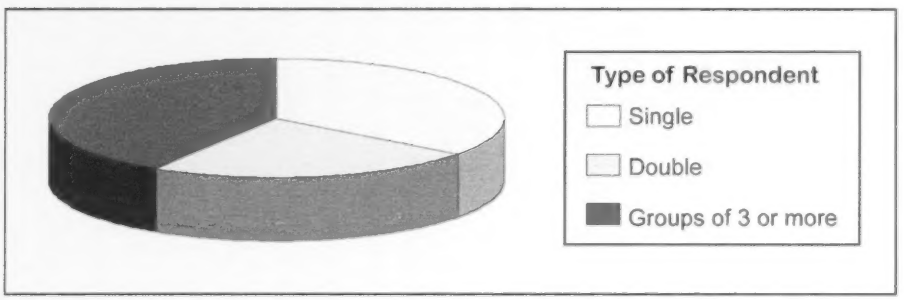

Figure 2. *Proportion of single, double, and group respondents to the AEC client needs assessment.*

Respondents within OMNR sections came from a broad range of disciplines with the majority having backgrounds in fisheries biology, fisheries ecology, biology, and protected areas conservation (Fig. 3). Sections with expertise in policy development, hydrology, and land and water ecosystem classification were also represented (Fig. 3).

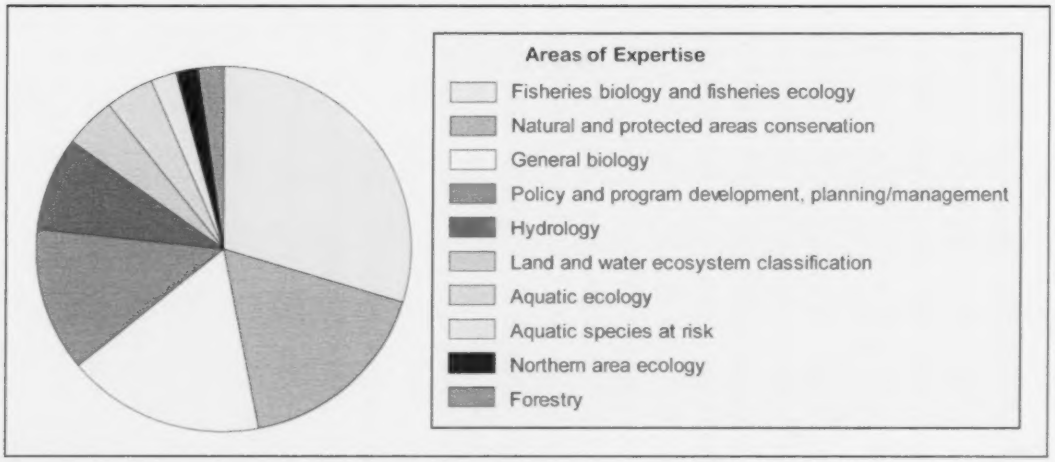

Figure 3. *Areas of expertise represented in respondents to the AEC, client needs assessment.*

Section 2: User needs and requirements

The vast majority of OMNR sections that responded confirmed the utility of a Province-wide Aquatic Ecosystem Classification in relation to a wide variety of user needs (Fig. 4). Only 2.7% of the questions in this section were left blank. The most consistently identified user needs were: surveying and inventory (i.e., monitoring) of aquatic features and biota; identification of sites that may support species at risk; and strategic planning for resource use and development (e.g., renewable energy projects). More than 95% of OMNR section respondents would find an AEC useful or somewhat useful for these purposes (Fig. 4).

Most users also identified that a Province-wide AEC would be useful for things like: modelling the occurrence and abundance of species; fisheries and habitat assessment and management; stratification of sampling efforts; identification of representative aquatic ecosystems for conservation planning; etc. There was some divergence over whether an AEC would be 'somewhat useful' or 'useful' for raising public awareness, or for the selection of reference sites (Fig. 4, *yellow* charts). But overall, all identified user needs for an AEC were confirmed as 'useful' or 'somewhat useful' by at least 81% of section respondents (Fig. 4). Many OMNR sections are not primarily focused on certain types of work (e.g., raising public awareness or State of the Resource Reporting). So a negative or ambiguous response could perhaps be interpreted as a mismatch between section objectives and potential AEC applications.

A number of additional needs were identified by responding sections and these are listed in Box 1. Some of these points could perhaps be amalgamated with the needs already identified in Figure 4; if - that is - those categories were broadened somewhat. For example, 'landscape-level resource reporting' might fit under 'landscape-level watershed based planning' (Box 1). Other user requirements were more specific, pertaining directly to specific acts, agreements, and projects (Box 1, e.g., Lakes and Rivers Improvements Act (LRIA) approvals and site specific planning requirements).

Email comments were received from several sections with specific suggestions and interests. We were extremely pleased with the level of interest, commitment, and number of detailed responses we received from this AEC, client needs assessment. A list of staff across the OMNR who indicated an interest in participating further in an AEC 'Science Team' has been compiled, and they will be contacted for further input as work proceeds on an Ontario-wide AEC.

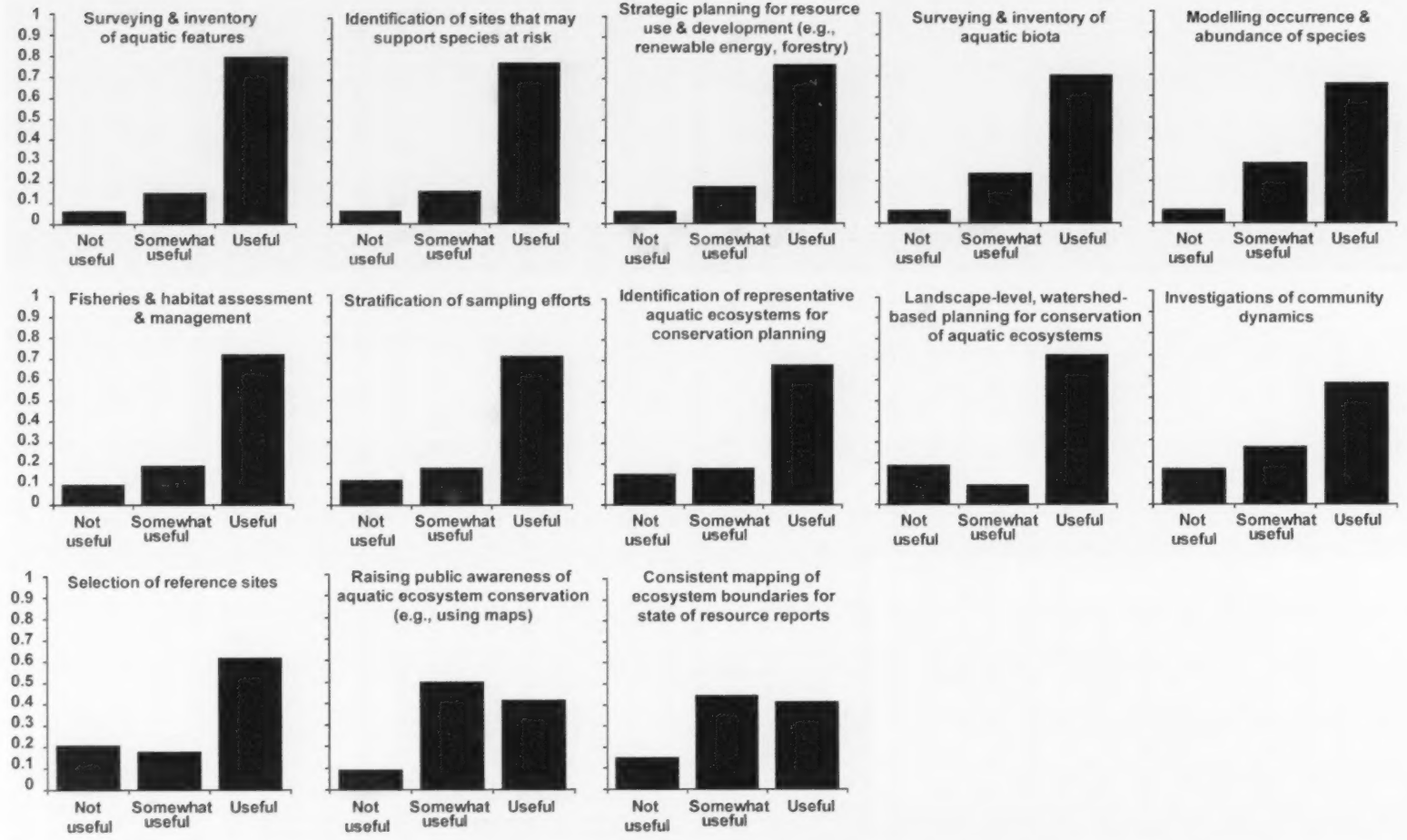
Surveying & inventory of aquatic features
Identification of sites that may support species at risk
Strategic planning for resource use & development (e.g., renewable energy, forestry)
Surveying & inventory of aquatic biota
Modelling occurrence & abundance of species
Fisheries & habitat assessment & management
Stratification of sampling efforts
Identification of representative aquatic ecosystems for conservation planning
Landscape-level, watershed-based planning for conservation of aquatic ecosystems
Investigations of community dynamics
Selection of reference sites
Raising public awareness of aquatic ecosystem conservation (e.g., using maps)
Consistent mapping of ecosystem boundaries for state of resource reports
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Not useful
Somewhat useful
Useful

Figure 4. *Summary of responses to user needs and requirements based on a sectional response to identified needs for a Province-wide, Aquatic Ecosystem Classification. Colours (red, orange, yellow) are subjective groupings depicting higher or lower agreement amongst the sections for that particular user need.*

Box 1: Additional user needs identified during the survey	Related
• Identifying ecosystem function (e.g., oxygenation, spawning sites etc.)	
• Vulnerability of the ecosystem (climate change, acidification, hydropower etc.)	
• Population genetics	
• Lakes and Rivers Act approvals ~ site specific planning requirements	
• Protected areas planning & PPCRA implementation (e.g., ecological integrity)	• Identification of representative aquatic ecosystems for conservation planning
• Identifying priority watersheds for COA projects, restoration, protection	
• Large-scale development proposals such as hydro electric development and mining develop	• Strategic planning for resource use and development (e.g., renewable energy)
• Landscape level resource reporting	• Landscape-level, watershed-based planning
• Meeting commitments to the Great Lakes Charter and Agreement	
• Noting AEC change with associated landscape uses	• Surveying and inventory of aquatic biota & aquatic features (monitoring & reporting)
• Compliance and effectiveness monitoring	
• Establishing Baseline AEC for monitoring and adaptive management	
• Contributes to consistent and efficient stratification of species or habitat level research studies/trials	• Stratification of sampling efforts
• Provides common ecosystem framework and language for practitioner communication, training and multi-constituent planning and negotiation	• Consistent mapping of ecosystem boundaries (e.g., for state of the resource reporting).
• Provides an objective framework for extrapolation of knowledge from area to area, provides a framework for development of ecosystem-based interpretations and applications; permits integration of knowledge across jurisdictional boundaries to achieve national and international objectives related to resource planning, evaluation and monitoring, biodiversity conventions, climate change conventions, etc.	

Section 3: Relevant strategic directions, legislation and policy documents

OMNR sections were asked to describe how an AEC or inventory would support specific policies or pieces of legislation that they use in their work. A considerable number of acts, policies, directions, and guidelines were indicated, spanning both Provincial and Federal documents, from the most strategic (i.e., *Ontario Biodiversity Strategy - OBS, Our Sustainable Future - OSF, Endangered Species Act - ESA, the Far North Act - FNA, Fisheries Act - FA*) down to specific ones (e.g., *Watershed-based Fisheries Management Planning Guidelines - WFiMPGs*, Box 2). Appendix 3 provides a catalogue of these responses. In sections three and four below, we summarize some of the main ways in which an AEC would support policies, guidelines, strategic directions and pieces of legislation mentioned by survey respondents. Many direct statements of client support were integrated in the text summarized below.

Why is an AEC needed?

An Aquatic Ecosystem Classification or aquatic inventory will addresses a range of central themes outlined in MNR's broad-level strategic directions including; healthy and resilient aquatic ecosystems, protecting ecosystem diversity, protection for endangered species, sustainable development of Ontario's assets, improving partnerships and awareness, as well as decision making and policy development.

Healthy and resilient aquatic ecosystems

OSF Goal 1, Strategy 1.2*b* (water management), 1.3*a* (integrated approach to aquatic ecosystem health) and 1.3*b* (Great Lakes management)

- Work to sustain water resources and their hydrological functions with other ministries, Conservation Authorities and other agencies.
- Support watershed-based source protection planning.
- Adapt and mitigate the impacts of climate change and other pressures using an integrated ecosystem approach to managing water resources.
- Enhance Great Lakes management effectiveness through integrated policy leadership, cooperation with other agencies and adopting best management practices.

A flexible and up to date AEC and aquatic inventory would allow physically-based, abiotic, classifications to be combined with predictive models of climate change to forecast potential shifts in the distribution of various freshwater biota. Given the likelihood of climate change and the dynamic nature of aquatic systems, large shifts in freshwater classification maps are expected. Therefore the dynamic nature of these systems must be considered.

If Ontario developed an AEC that is compatible or complementary to aquatic classification efforts developed for the Great Lakes (offshore), then the AEC framework would help satisfy identified needs for Great Lake fish community goals and

environmental objectives. AEC would also help achieve various species management and broad diversity objectives in rivers and streams entering the Great Lakes system.

Watershed and catchment based Aquatic Ecosystem Classification serves as the basis for so many aspects of resource assessment, inventory, mapping, evaluation, monitoring, research, planning and reporting that the objectives stated in our broad policy statements are really only achievable if we develop consistent and comprehensive tools like AEC.

Protecting genetic, species, and ecosystem diversity

OBS Goal 1, OSF, Strategy 1.1*e* (natural heritage) and 1.1*f* (parks and protected areas). These strategies are designed to conserve Ontario's biodiversity by

- determining opportunities for enhanced conservation
- encouraging natural heritage systems planning
- protecting natural heritage lands in Southern Ontario
- expanding a system of protected areas in the Far North working with Aboriginal communities
- working with the federal government for conservation in and around the Great Lakes.
- *OBS* (ecosystem representation and integrity) developing a framework for assessing aquatic ecosystem representation
- *OBS* (*action* 22, 24, 25)

Survey respondents indicated a variety of legislations that serve to help implement these strategies including *PPCRA, PAPM, PPS, PMP92, ANSI policy, FNA, the Far North land-use strategy, draft PFMO's, GLC, JSPGLFM, NEP and NEPDA* (see Box 2 for acronyms). All of these legislative tools provide grounds to acquire and protect representative aquatic areas. For example, one of the purposes of the *Provincial Parks and Conservation Reserves Act – PPCRA* is to protect ecosystems representative of Ontario's biodiversity. The PPCRA 2006, Section 8(8), includes the creation of an aquatic class of parks, which is yet to be proclaimed in the PPRCA. An AEC would assist with developing and implementing a scientific and policy framework for the new aquatic park class. An Aquatic Ecosystem Classification would aid in the development of a framework for assessing representation of aquatic ecosystems in the provincial protected areas system. AEC would help to identify gaps in protection and targets for securement. Without an AEC, there is limited ability to assess how the *PPCRA* goals are being met with respect to protection of aquatic ecosystems in parks and conservation reserves, as well as with respect to how specific park class objectives are being achieved. An AEC would also be useful for rationalizing the boundaries of protected areas and to inform management and restoration strategies at different scales.

Protection for endangered species

OSF, Strategy 1.1*c*, *OBS*, action 19. Implement the *Endangered Species Act-ESA* including habitat protection and recovery measures to improve the status of species and their habitats.

Additional supporting legislation or policy guides to fulfill this goal include the *Fish and Wildlife Conservation Act – FWCA,* and *the Far North land-use strategy.* An Aquatic Ecosystem Classification is paramount to understanding (via prediction and modelling)

the expected distribution and abundance of species across the landscape. This would allow us to target areas where SAR are likely to occur for inventory, monitoring, and adaptive management. This tool would be particularly useful in areas where data are sparse (e.g., the Far North). AEC would aid in the identification of potential critical habitat and the identification of unique areas for protection (e.g., spawning areas, brook trout streams, presence of sturgeon). An AEC would improve our ability to protect key aquatic habitat features, and this would provide assistance with options for *ESA 17(2)(c)* permitting (e.g., assessing overall benefit, reasonable alternatives, and steps to minimize adverse effects). AEC would help in modelling (predicting) rates of spread and occurrence of aquatic invasive species.

Sustainable development of Ontario's assets

OSF, Strategy 1.1*b* (conserve biodiversity, *action*: integration), Strategy 2.1 (enable opportunities for renewable energy)

- Integrate biodiversity conservation considerations into resource management, from policy and program development to delivery.
- Science and research - Use science to support and inform renewable energy opportunities and policies
- *OBS action 12:* Implement the 2005 *Provincial Policy Statement* under the *Planning Act* to ensure effective direction to promote managed growth, sustainable development, a strong economy and a healthy environment.
- *FNA, land use planning section 5.2* Enable sustainable economic development that benefits the First Nations.

Aquatic Ecosystem Classification is a framework or foundation for sustainable ecosystem-based planning and conservation. AEC provides context for planning within the *LRIA, WFiMPG's, CFSA, ESA, NHAG for REP, SPOF II*, and most other fisheries management policies and documents. With respect to the Fisheries Act, an AEC system would help in the review of development proposals. AEC would also help to develop mitigation measures and possibly compensation plans. An AEC will be integral to the review and development of fisheries policies for protected areas.

An AEC may inform potential strategic planning for waterpower projects and could assist in strategic-level planning for hydro development (within different aquatic ecosystem types).

An AEC would be useful for Far North community-based, watershed-wide planning under the *Mining Act – MA* and the *Environmental Assessment Act – EAA*

AEC would help the OMNR to contribute to *SPOF II's* commitment to managing with an ecosystem perspective and may further inform definitions of stocks. AEC would help guide monitoring and reporting of sport fish status across Ontario. AEC helps to guide sustainable allocation and harvest discussions.

Aquatic Ecosystem Classification would be an important tool for guiding land-use planning in southern Ontario. The *Niagara Escarpment Plan - NEP* requires considerations of cumulative effects and water resources (quantity, quality, wetlands and

fisheries) as well as environmental monitoring requirements which would be enhanced by AEC.

A classification would allow OMNR to establish sensitive and prone areas to floods and drought, to better manage water resources under the *Ontario Water Resources Act – OWRA*, *Emergency Management and Protection Act – EMPA*, and the *Ontario Low Water Program – OLWP*, *Flood Forecasting*. Establishing priority water use during drought is an example of how an AEC could be used. Knowledge about the state of rivers and streams (physical parameters) would also help in decision making.

Under the *Crown Forest Sustainability Act – CFSA*, an AEC could possibly be used for identifying aquatic values (*Provincial Stand and Site Guide*) and to help perform risk assessment for road placement in *Forest Management Plans - FMP's*. AEC would be useful for investigating cumulative effects of water crossings on watershed function.

Class EA-PPCR is used to assess the impact of projects that occur in provincial parks and conservation reserves. An AEC would be used during the screening process to assess if fish or other aquatic species, communities, their habitats or natural heritage features (e.g., ANSI's, provincially significant wetlands) would be impacted. The AEC would also be used in the project evaluation process to identify significant aquatic features (e.g., best/largest examples of different ecosystems, rare or unique elements) that will need special consideration for impact assessment, mitigation and post-construction effects monitoring.

Improving partnerships and awareness

OSF, Strategy 5.3 (create relationships with Ontario ministries and other levels of government); *OBS, action 30* (improve understanding)

- Continue to support Ontario's involvement in national and international conservation initiatives.

Many projects stemming from the *Canada Ontario Agreement* (on the Great Lakes) are based in GL tributaries and focused on restoring habitat, species and improving the quality of the Great Lakes. Related legislation includes: *Great Lakes Water Quality Agreement - GLWQA*, *Great Lakes Charter and Agreement* – GLC and *Boundary Waters Treaty*). An AEC could be useful in identifying priority areas for projects, species restoration and prioritizing projects for funding.

MNR delivers the Surface Water Monitoring program and supports water budgeting (source water protection) as well as maintains the Water Resource Inventory Program. AEC could be integrated or directly linked to a WRIP based IM system.

An AEC would assist the Ministry of Environment in reviewing water taking proposals.

Decision making and policy development

As mentioned above, an AEC would support policy development and regulation of the yet to be proclaimed aquatic class park category as per *PPCRA* (Section 8(8)).

MNR is expected to develop new guidance on cumulative effects assessment. An AEC would assist by providing a basis for investigating the effects of human activities on elements of aquatic biodiversity over different temporal and spatial scales.

Ecological Framework for Recreational Fisheries Management - EFFM: An AEC could help to further define fisheries management zones, particularly in the case of migratory species whose life history range currently crosses FMZ boundaries. Aquatic ecosystem functioning and habitat protection are issues and management challenges in every FMZ plan so far. This will help develop management actions (e.g., support stratified monitoring, data analysis, reporting). An AEC would help guide monitoring and reporting of sport fish status across Ontario.

Box 2.	Acronyms for legislation / policies / acts
ANSI	ANSI Policy
BWT	Boundary Waters Treaty
CAA	Conservation Authorities Act
Class EA for PPCR	Class Environmental Assessment for Provincial Parks & Conservation Reserves
CEA for OW	Class Environmental Assessment for Ontario Waterpower
CFSA	Crown Forest Sustainability Act
COA	Canada Ontario Agreement
EAA	Environmental Assessment Act
EFFM	Ecological Framework for Recreational Fisheries Management
EMPA	Emergency Management and Protection Act
ESA	Endangered Species Act
FA	Federal Fisheries Act
FMPGs	Forest Management Planning Guidelines
FMZ	Fisheries Management Zones
FNA	Far North Act / Far North Land Use Strategy
FWCA	Fish and Wildlife Conservation Act
GEA	Green Energy Act
GLC	Great Lakes Charter and Agreement
GLWQA	Great Lakes Water Quality Agreement
JSPGLFM	Joint Strategic Plan For Great Lakes Fisheries Management
LaMP's	Lakewide management planning (LaMP's)
LRIA	Lakes and Rivers Improvement Act
MA	Mining Act
NEP	Niagara Escarpment Plan
NEPDA	Niagara Escarpment Planning and Development Act
NHAG for REP	Natural Heritage Assessment Guide for Renewable Energy Projects
OBS	Ontario's Biodiversity Strategy
OLWP, FF	Ontario Low Water Program, Flood Forecasting.
OSF	Our Sustainable Future
OWRA	Ontario Water Resources Act
PA	Parks Act
PAPM	Protected Areas Planning Manual
PFMO's	Provincial Fisheries Management Objectives (draft)
PLA	Public Lands Act
PMP	Planning and Management Policies 1992 Update (Blue Book)
PPCRA	Provincial Parks and Conservation Reserves Act 2006
PPS	Provincial Policy Statement 2005
SORR	State of the Resource Reporting
SPOF II	Strategic Plan for Ontario Fisheries II
SPRRED	Strategic Policy Review Renewable Energy Development on Crown land
SS for OSF	Science Strategy for Our Sustainable Future
WCA	Water Conservation Act
WFiMPGs	Watershed-based Fisheries Management Planning Guidelines

Section 4: User needs, scale, and related goals / policy

Respondents were invited to specify scale(s) of application (i.e., catchment, watershed, basin, and/or provincial) associated with identified AEC user needs. Figure 5 summarizes the proportion of section-level responses that specified a given scale of application for a particular user need. Certain activities such as; strategic planning, reporting, landscape-level planning, and policy development require ecosystem information summarized at broader spatial scales (Figure 5). Whereas, in order to be useful for things like: modelling the occurrence and abundance of species; surveying aquatic features and biota; examining community dynamics; and providing direction on where to sample – finer scales tend to be more relevant (Figure 5). This division of needs at different and overlapping scales justifies the need for a hierarchical or multi-scale classification of aquatic ecosystem units.

Data on species occurrence patterns or unique aquatic features are often collected at fine spatial scales, but results need to be communicated at broader scales. As a strategic planning tool, mid to upper scales of an AEC can be used to select reference sites and assess the capabilities/sensitivities of these systems and the broad impacts of various development projects (via monitoring and evaluation). Upper levels in the classification can be designed to inform strategic corporate documents and landscape-level, land-use planning and policy. Provincial and regional scales are useful for summarizing broad-scale trends (e.g., related to climate change) or for generalizing and reporting on trends found.

Table 1 presents a summary of section-level responses that describe how an AEC could be used to help achieve a variety of goals and activities mandated by relevant official policy or legal tools. Clearly there are very few policy initiatives that are not fundamentally served by classification efforts. As one respondent put it, '*all policy and program documents would be enhanced if an (aquatic) ecological framework was used*'.

For example, classifications of aquatic catchments, between 10 and 100 km^2 (level III), will be made on the basis of a variety of abiotic variables such as:

- Position in the watershed
- Lake Effects
- Bed and Valley Geology
- Bed and Valley Slope
- Lake & Channel Morphometry
- Catchment and Riparian landcover
- Solar Radiation
- Lake & Valley Aspect/Depth

The exact attribute list will be refined by the AEC Science Team. If researchers are interested in getting direction for sampling efforts, level III could depict all catchments with slopes and incoming solar radiation < or > a specified value, given a particular soil or bedrock geology, for example. The researcher or land-use planner could have an *a priori* expectation that such catchments have a high likelihood of containing brook trout.

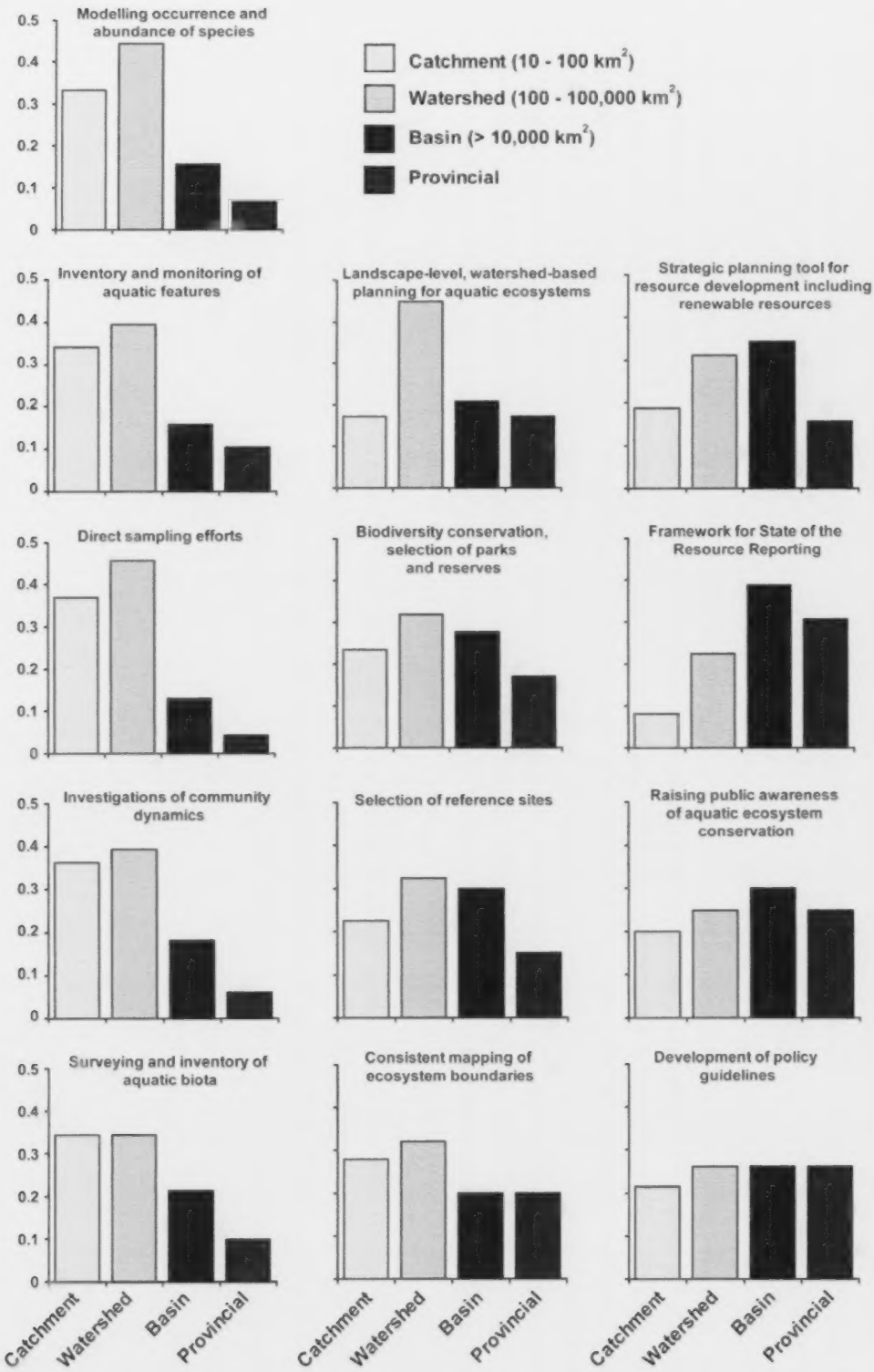

Figure 5. *Summary of responses to questions about the scales at which various user needs apply.*

Table 1. Linking user needs to specific goals, activities, and OMNR strategic directions, policies, and legislation.

User needs	Goal/Activity	Strategic Direction, Legislation, or Policy[1]
Framework for reporting (e.g., State of the Resource)	Provides a primary framework for organization, collation, analysis of information, trend analysis, communication and reporting for State of the Resource Reporting (SORR) and Protected Areas Planning (i.e., PPCRA, aquatic ecosystem representation goals). An AEC would provide an ecological framework for reporting on progress towards meeting fisheries management objectives within Fisheries Management Zones (FMZ).	EFFM; ESA, FNA, FWCA, LaMPs, LRIA, OBS, OSF, PFMOs, SORR, SPOF II; Supports MNR's water mandate; supports EA, LRIA, and ESA reviews. FWCA - park management plan, land claim negoatiations; OBS, fish species restoration and management planning, LaMPs, fish community objectives; OSF status reports on the state of natural resources in Ontario.
Consistent mapping of ecosystem boundaries	A multi-scale AEC would delineate and map boundaries, and define ecological driving variables. This is important for: 1) selection of protected areas and natural heritage areas; 2) establishing baselines for monitoring and inventory; 3) relating FMZ boundaries to aquatic ecosystem boundaries; 4) meeting COA commitments for reporting, delivering and measuring progress, areas of impact, etc.; 5) landscape planning and decision-making with respect to water resources, fisheries and forest management planning.	Spans all OMNR policies, directions, and legislation, from most strategic (OBS, OSF, FNA) to specific (ANSI policy, CEA for PPCR, CEA for OW, CFSA, COA, EFFM, EMPA, ESA, FA, FWCA, GEA, GLWQA, LaMPs, LRIA, NEPDA, OWRA, PA, PAPM, PLA, PMP, PPCRA, & PPS). Relates to outreach & things like: the Great Lakes Cities Initiative; flood forecasting and low water; Fish Species Restoration & Management Planning; & Fish Community Objectives.
Direct sampling efforts	An AEC could be used to: 1) enable stratifed sampling of "like types" to help set priorities for inventorying, monitoring, and conservation of aquatic ecosystems; 2) help direct sampling efforts towards areas where SAR are predicted; 3) direct selection of specific parks for monitoring, inventory, and modelling of aquatic biota (e.g., fish populations); 4) select representative flowing waters for sampling, research, assessment & evaluation (e.g., of waterpower development).	CEA for OW, ESA, JSPGLFM, LaMPs, LRIA, NEP, restoration and management planning, and fish community objectives.
Landscape-level, watershed-based planning for aquatic ecosystems	An AEC is necessary to ensure consideration of aquatic ecosystems in land use planning and contributes to watershed-lake-based, fish managment plans, system planning, and Far North community-based planning. Assessment and evaluation of rivers in relation to their hydrology, water supply, and water quality should help with landscape-level, watershed-based planning to understand how water can be allocated on a watershed basis. In the Far North and NE Region, an AEC could be used to develop a framework for strategic river planning.	CAA, EMPA, ESA, CFSA, FA, GEA, LaMPs, LRIA, NEPDA, OWRA, PLA, SORR, WFiMPGs, water taking agreements, invasives, harvest regulation, protection and restoration directives, strategic resource evaluation (like renewable energy for example), relates to various water mandate activities, flood forecasting and low water, restoration and management planning, and fish community objectives.
Biodiversity conservation, selection of parks and reserves	Ensures appropriate representation of aquatic ecosystems in protected areas. Protect areas where SAR may occur. Helps to delineate protected area boundaries. Useful for ecosystem planning, Far North community-based planning, defining sanctuaries, fisheries and forest management planning, biodiversity natural heritage protection, protection and maintenance of ecosystem integrity, species-specific restoration and management.	EFFM, ESA, LRIA, OBS, NEP and associated Niagara Escarpment Parks and Open Spaces System, PA, PFMO's, and PPCRA. Use in a cumulative effects context within LRIA and/or Far North Act to strategically articulate which rivers and river types are "open for business", which are "reference" rivers, legacy rivers etc.
Modelling occurrence and abundance of species	An AEC could be useful in: 1) developing predictive models of where SAR occur on the landscape; 2) general species modelling to get at measures (hypotheses/predictions) of biodiversity; 3) to model invasive species bioclimatic envelopes; 4) to assess (hypothesize/predict) biodiversity and habitat for further monitoring & research; and 5) to assess fisheries stocks (e.g., from broad-scale monitoring data) in relation to aquatic ecosystem boundaries.	CEA for OW, ESA, FA, FWCA, GEA, JSPGLFM, LaMPs, LRIA, OSF, habitat related directives, operational activities like harvest regulations; park management planning, land claim negotaitions, restoration and management planning, fish and community objectives.
Development of policy guidelines	An AEC would be useful for: 1) developing policy guidelines for protected areas planning, selection, and design; 2) reviewing development proposals to mitigate impacts from development; 3) providing an ecological framework and overall structure for policy development, cumulative effects assessment, baseline guidelines for renewable energy, mining, park management planning, restoration and management planning, fish community objectives, fisheries and forest management planning, species-specific restoration and management, planning and communication, monitoring, allocation and adaptive management; 4) supporting COA commitments - fulfilling some of the requirements for compliance with inter-jursidictional agreements.	ESA, CFSA, COA, FA, OSF, SPOF II, LaMPs, NEP, PFMOs, PLA, PPCRA. Use in a cumulative effects context within LRIA and/or Far North Act to strategically articulate which rivers and river types are "open for business", which are "reference" rivers, legacy rivers etc.

User needs	Goal/Activity	Strategic Direction, Legislation, or Policy[1]
Strategic planning tool for resource development including renewable resources	AEC supports cumulative impact assessment of waterpower development as well as other resource development activities by providing a multi-scale (Provincial, basin, watershed, catchment) and strategic approach to determining when and where development on the landscape can occur. In the Far North and NE Region, an AEC could be used to develop a framework for strategic river planning. The AEC would set a reference baseline for different ecosystems so that the cumulative effects of various developments can be assessed (e.g., effects of water removal, diversions, mining, dams, waterpower development, renewable and non-renewable resource extraction, fisheries and forest practices).	CFSA, ESA, FA, GEA, LaMPs, LRIA, NEP, OSF, PLA, PPCRA, SPOFII, SPRRED. Use in a cumulative effects context within LRIA and/or Far North Act to strategically articulate which rivers and river types are "open for business"; which are "reference" rivers; legacy rivers etc. Commitments of the Great Lakes Charter and Agreement; renewable energy, park management planning, restoration and management planning, fish community objectives
Fine scale resource planning tool	Consistent and repeatible aquatic planning units at a variety of scales would be useful for resource values identification, inventory and planning (forestry, development, renewable energy). A fine-scale AEC could be useful for dam and other water infrastructure approvals/guidance. - AEC provides a framework for environmental impact assessment and monitoring	CFSA, ESA, RE, regional strategic resource guidelines, protection and restoration guidelines
Selection of reference sites	As mentioned above, an AEC would be useful as a stratification tool to establish baseline or reference conditions for strategic planning, objectives setting, assessments of representativeness, and assessments of needed rehabilitation, stocking or mitigation efforts.	CFSA, COA, ESA, JSPGLFM, PPCRA, SORR, strategic planning, target setting, commitments to Lake Erie LaMP's and park management planning, restoration and management planning, and fish community objectives
Surveying and inventory of aquatic biota	Reporting on presence/absence and distribution of invasive species; confirm presence of SAR to assist in protecting SAR and habitat (e.g., habitat regulations); species-specific restoration and management, planning and communication; assess presence/absence and abundance of aquatic species; biotic inventories. Trend through time fisheries data - compile information on fish habitat and populations within ecosystem types.	CEA for OW, CFSA, COA, ESA, FA, JSPGLFM, LaMPs, LRIA, OBS, PLA, PPCRA, Invasive Species Policy, Great Lakes FCOs, Renewable Energy, Park management planning, restoration and management planning, and fish community objectives.
Inventory and monitoring of aquatic features	A fine scale AEC could predict, habitat conditions for SAR to help guide ESA permitting. AEC provides a mechanism for monitoring abundance, productivity and change. AEC could serve as a basis for development of best practices. If aquatic classification extends to Great Lakes, shoreline and off-shore (deepwater) habitat, it would support shoreline and offshore mapping and protection, etc. Monitoring aquatic features within ecosystems would aid understanding of effects of climate change and factors that influence productivity of waterbodies (for example).	CEA for OW, CFSA, COA, EMPA - flood forecasting and low water, EFFM, ESA, FA, JSPGLFM- Lake Erie environmental objectives, LaMPs, LRIA, NEP, OSF, OWRA, PLA, PPCRA, Renewable Energy, SPOF II, park management planning, restoration and management planning, and fish community objectives
Investigations of community dynamics	An AEC could be used to study and measure ecosystem function, solidifying/testing the current (ecosystem classification) approach. AEC would help with investigating Great Lakes (e.g., Lake Erie) fish community goals and objectives.	CFSA, EFFM, ESA, FA, GEA, JSPGLFM, LaMPs, OSF, PPCRA, SPOF II, plan for hydro-electric, productivity-harvest regulations, habitat management, renewable energy, park management planning, restoration and management planning, and fish community objectives.
Raising public awareness of aquatic ecosystem conservation	Useful in various ways right across the board for public awareness (e.g, natural heritage education programs, water conservation, outreach to stakeholders). Useful for communicating connectivity of inland surface water & wetlands to the Great Lakes. AEC maps can be used for outreach & communication.	ESA, CFSA, LaMPs, NEP, PPCRA, and WCA.

[1] refer to Box 2 for acronym definitions

Concluding recommendations

We have needed an Aquatic Ecosystem Inventory and Classification framework in the Province of Ontario for over 20 years. Can we afford to wait any longer? Community-based planning in the Far North is proceeding, yet there is a need for Province-wide, science-based, knowledge of what is there. Where and what aquatic ecosystem components do we have in the Far North of Ontario at various scales? What are the assembly rules? How much is there and how is it changing? In Southern Ontario, a finer-scale inventory of freshwater aquatic ecosystems and their habitat features is necessary to support species at risk planning and landscape-level, watershed-based planning in rural and agricultural areas. We need to build and expand on the work that has already been done (e.g., the Blueprint Project, Natural Hazards Guidance) and take planning to the next level (Provincial, National, International). An opportunity exists now to build on the Ecological Framework for Fisheries Management (EFFM) so that all freshwater systems and taxonomic groups in Ontario are given due consideration. Now that we have some momentum for freshwater research in Ontario with the Broad-Scale monitoring program, it is time to address some of these critical concerns.

Appendix 1: Client Needs Assessment Survey and AEC Factsheet

Aquatic Ecosystem Classification

Client Needs Assessment Survey

Ministry of Natural Resources

Ontario

Aquatic Research and Development Section
Ontario.ca/aquaticresearch

The **purpose** of this survey is to assess information needs of the OMNR for the development of an aquatic ecosystem classification (AEC) system. **A consolidated section or program level response is desired.**

Results of this survey will help determine the primary purpose, area(s), and scale(s) under which the majority of users require an Aquatic Ecosystem Classification and aquatic inventory to assist with their work. A summary of the results will be provided to all sections at their request. The following example sentences describe the type of information we are looking for:

> We need an Aquatic Ecosystem Classification for '*YOUR CLIENT NEED*' at '*WHAT SCALES*' to help achieve '*WHAT GOALS*' under '*WHAT POLICY, LEGISLATION, OR STRATEGIC DIRECTION*'.
>
> **Examples:**
>
> 1) We need an Aquatic Ecosystem Classification to 'create a system of protected freshwater parks' at the 'watershed scale' to help 'conserve Ontario's biodiversity' under the 'Provincial Parks and Conservation Reserves Act'.
>
> 2) We need an Aquatic Ecosystem Classification to 'plan for hydroelectric development' at the 'catchment, watershed, and provincial scale' to help 'enable opportunities for renewable energy' under the 'Green Energy and Green Economy Act'.

Your participation is crucial to the success of the survey. Your group was deliberately invited to participate because of your knowledge and experience regarding this topic. At the end of this survey, you will be invited to provide the name of an individual that would like to be involved as a member of an aquatic classification science team.

If you have any questions or comments regarding the survey, please contact:

Stephanie Melles
Stephanie.melles@ontario.ca
Tel: (705) 755-1580

Nicholas Jones
Nicholas.jones@ontario.ca
Tel: (705) 755-2268

The survey should take approximately ½ hour to complete and will be accompanied by a project fact sheet and short power-point presentation describing the project.

Thank you in advance for your time and effort.

CLIENT NEEDS ASSESSMENT SURVEY

AQUATIC ECOSYSTEM CLASSIFICATION

Section 1: Organizational information

Which OMNR division, branch, and section do you work in? **Please specify using the drop down menus provided:**

Division | Branch

Section

What region(s) and district(s) in Ontario do you work in? **Please specify:**

How many people contributed to filling out this survey?

What are their areas of expertise?

Section 2: User needs and requirements

The following user needs were identified by various OMNR staff in relation to Aquatic Ecosystem Classification (AEC). How useful would an AEC be within your section/program area for each of these identified needs on a scale of 1 to 3 (where 1 = not useful, 2 = somewhat useful, 3 = useful)? Users are invited to add to this list at the bottom of the chart.

Biodiversity Conservation	Identification of representative aquatic ecosystems for conservation planning	○ 1	○ 2	○ 3
	Identification of sites that may support species at risk	○ 1	○ 2	○ 3
Land-use Planning	Landscape-level, watershed-based planning for conservation of aquatic ecosystems	○ 1	○ 2	○ 3
Resource Management	Strategic planning for resource use and development (e.g., renewable energy, forestry)	○ 1	○ 2	○ 3
	Fisheries and habitat assessment and management	○ 1	○ 2	○ 3
Inventory and Monitoring	Consistent mapping of ecosystem boundaries for state of resource reports	○ 1	○ 2	○ 3
	Stratification of sampling efforts	○ 1	○ 2	○ 3
	Surveying and inventory of aquatic biota	○ 1	○ 2	○ 3
	Surveying and inventory of aquatic features	○ 1	○ 2	○ 3
	Selection of reference sites	○ 1	○ 2	○ 3
Research	Modelling occurrence and abundance of species	○ 1	○ 2	○ 3
	Investigations of community dynamics	○ 1	○ 2	○ 3
Education & Awareness	Raising public awareness of aquatic ecosystem conservation (e.g., using maps)	○ 1	○ 2	○ 3
	Other (specify)	○ 1	○ 2	○ 3
	Other (specify)	○ 1	○ 2	○ 3
	Other (specify)	○ 1	○ 2	○ 3

CLIENT NEEDS ASSESSMENT SURVEY
AQUATIC ECOSYSTEM CLASSIFICATION

Section 3: Relevant strategic directions, legislation and policy documents

Please check off the key OMNR strategic directions documents that guide your work.

- ◯ Our Sustainable Future
- ◯ Science Strategy for Our Sustainable Future
- ◯ Ontario's Biodiversity Strategy
- ◯ Far North Land Use Strategy

Specify additional ones:

In your opinion, which specific policies or legislation that you use in your work may be supported by an Aquatic Ecosystem Classification or aquatic inventory? Please specify below.

For each of the documents you listed above, please describe how an Aquatic Ecosystem Classification and aquatic inventory would support them.

CLIENT NEEDS ASSESSMENT SURVEY

AQUATIC ECOSYSTEM CLASSIFICATION

Section 4: User needs, scale, and related goals / policy

This question puts it all together to create the example sentences described at the beginning of this survey (refer to page 1 for examples). Please select a client need from the drop down menu or specify your own. Check off the scale(s) that apply and specify the goal/activity and the relevant strategic direction, legislation, or policy document. Use as many rows as required.

Client Need	Catchment (10-100 km^2)	Watershed (100 - 100,000 km^2)	Basin or Region (> 10,000 km^2)	Provincial	Goal / Activity	Strategic Direction, Legislation, or Policy
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		

CLIENT NEEDS ASSESSMENT SURVEY
AQUATIC ECOSYSTEM CLASSIFICATION

Section 5: Aquatic Science Team

Is there an individual within your section that would be willing to participate as a member of an internal OMNR, AEC review team? Members of this team would be invited to review AEC materials approximately twice per year.

Please specify their name(s):

Thank you for completing the survey!

Diving in: Aquatic Research and Development Project Profile Series

Aquatic Ecosystem Classification (AEC)

What is Aquatic Ecosystem Classification?

Ecological classification is the process of mapping ecologically distinctive areas on earth. Currently Ontario has a land-based map that identifies unique terrestrial ecosystems based on climate, geology, soil type, and vegetation cover, known as the Ecological Land Classification (ELC) system (Figure 1). This land-based map does not adequately capture the diversity of aquatic ecosystems in the Province. An aquatic classification will be designed specifically to represent the diversity of watersheds, lakes, rivers, shorelines, wetlands, and streams in Ontario. Our overall goal is to establish a comprehensive and consistent province-wide approach to aquatic ecosystem description, inventory, and interpretation. Such a system would complement the current terrestrial Ecological Land Classification system.

What might an Aquatic Ecosystem Classification look like?

The proposed classification will focus on the abiotic template that supports a diversity of aquatic life. Many abiotic variables can be measured remotely and this facilitates spatial analysis and mapping in regions with inadequate field data (e.g., the Far North). At the broadest spatial scales (i.e., levels 1 and 2), static ecosystem maps will be produced showing aquatic 'ecozones' (level 1), with aquatic 'ecoregions' (level 2) nested within these zones.

Level 1 would capture broad scale ecosystem variability using bedrock geology and physiography (i.e., landforms and physiographic regions). This level will likely tie in with current provincial and federal ecological land zones, while honouring watershed boundaries.

Figure 1. Map of broad-scale ecological land zones in Ontario (colours) showing major rivers and lakes. Notice how river systems cross ecological land zones. Level 1 of an Ontario aquatic classification would be created to match ecological processes at this scale.

Why do we need an AEC?

An aquatic ecosystem classification would provide a framework to:

- *Report on the 'State of the Resource' e.g., in terms of aquatic biodiversity*
- *Perform landscape-level, watershed-based planning for aquatic ecosystems in different MNR sectors (e.g., Far North, Renewable Energy, Natural Heritage and Southern Region).*
- *Stratify sampling efforts for broad scale monitoring of aquatic ecosystems (including streams, rivers, and lakes).*
- *Select reference watersheds for monitoring*
- *Identify gaps in the current Provincial representation of aquatic class parks and protected areas.*

Level 2 (Figure 2) would capture medium scale ecosystem variability between quaternary watersheds. Potential factors could include: landscape morphology (e.g., elevation), climate (e.g., growing degree days), ground and surface water baseflow, lake and wetland cover, morphometry (e.g., size, shape, depth), soil, geology, conductivity and turbidity. Note that quaternary watershed boundaries are not currently available for the Far North, but progress is being made towards creating seamless hydrographic layers that cover the entire province.

Figure 2. Example of a level 2 aquatic classification of quaternary watersheds in a portion of Southern Ontario.

Aquatic ecosystems become increasingly dynamic at finer spatial scales. They change more rapidly in both time and space and management needs get more specific as well. **Level 3** is envisioned to become a flexible mapping system tailored to address this diversity of user needs at finer scales. Users will be able to specify ecological drivers and rules to create maps that suit their unique management goals. The algorithms (i.e., processing rules) and the maps they produce can be stored and easily re-used and shared with others. These maps will also provide a gateway to an online aquatic ecosystem inventory, making mapping a collaborative effort. Level 3 would capture stream segments (100 m to 10 km in length) as well as whole lake and wetland systems using variables like network position, geology, morphometry, slope/aspect/depth and landcover within reach contributing areas.

Whereas **level 4** is a validation level that captures finer site scale details (1 – 100 m) such as pools and riffles, which form within even shorter temporal periods (e.g., 10 years). Level 4 relies on field-based measures.

AEC Products, Phase 1:

Year 1 (2010-2011)

- Literature review of AECs in use around the world
- Concept paper on development of an Ontario AEC
- Client needs assessment
- Establishment of an MNR aquatic classification science team

Year 2 (2011-2012)

- Meeting with MNR Science team to review the AEC conceptual framework
- Technical paper describing measures of lake-stream networks in Ontario
- Straw-dog maps of levels 1 & 2
- Conceptual basis for levels 3 and 4 (inventory and decision support system)

During Phase 2 (2012-2014+) of the AEC project:

- Development of an online Aquatic Ecosystem Inventory and Decision Support System is proposed.
- Pilot projects to test the classification, sample identified areas, and investigate issue of aquatic representation in protected areas could be undertaken.

Research Team Partners & Collaborators

Aquatic Research Team:

- **Nicholas E. Jones**, Research Scientist, Aquatic Research & Development Section, MNR
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- **Stephanie Melles**, Postdoctoral Researcher, Aquatic Research & Development Section, MNR/Trent University
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- **Bastian Schmidt**, Analytical Ecologist, Aquatic Research & Development Section, MNR
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Proposed Aquatic Classification Science Team:

- Expert members from different divisions in the Ministry of Natural Resources (Science and Information Branch, Geographic Information Branch, Biodiversity Branch, Regional Operations Division, Far North Branch, and Natural Heritage, Lands and Protected Spaces Branch)

Appendix 2: Survey Circulation

A. Policy Division:

1. Natural Heritage, Lands and Protected Spaces Branch
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D. Regional Operations Division:

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Appendix 2: Survey Circulation

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    26. Far North Planning Section
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* Initially not on the circulation list, but interested in the providing input on the survey and AEC

Appendix 3: Strategic directions, legislation and policy documents supported by an AEC

Our Sustainable Future (OSF): An AEC would support strategies 1.1e & 1.1f (conserve biodiversity by protecting natural heritage, parks & protected areas). AEC would help us to achieve our mission of ecological sustainability since it would help us to manage our natural resources in an ecologically sustainable way to ensure they are available for future generations. It would also help us to achieve the 1st goal which is a healthy environment for Ontarians. It also contributes to strategies 1.1, 2.1 and 5.3. AEC would be an important tool for guiding land-use planning in southern Ontario. The ability to use a biologically appropriate aquatic ecosystem framework to classify AE's will be beneficial to assessing the status of fisheries and therefore their sustainability.

Science Strategy for Our Sustainable Future (SS for OSF): Allows for better focused research in Ontario's Far North for which data is currently sparse.

Ontario's Biodiversity Strategy (OBS): Identifying areas for protection based on habitat, species, and genetic (stock) rarity. Supports achievement of Goals 1 and 2 plus implementation of a number of actions including action 12, 19, 22, 24 and 30 (there are others). It would allow for identification of unique eco-region specific management (planning, implementation, state of the resource reporting). It would aid in the protection of critical habitat and identification of unique areas for protection (Ontario's Biodiversity Strategy); An AEC is paramount to understanding and predicting the distribution and abundance of species across the landscape. This tool would be particularly useful in areas where data are sparse.

Strategic Plan for Ontario Fisheries (SPOF II): AEC would help the OMNR to contribute to SPOF II's commitment to managing with an ecosystem perspective and may further inform definitions of stocks. AEC would help guide monitoring and reporting of sport fish status across Ontario.

Provincial Fisheries Management Objectives (PFMOs -draft): AEC supports acquisition of aquatic protected areas.

Ecological Framework for Recreational Fisheries Management (EFFM): An AEC could help to further define fisheries management zones, particularly in the case of migratory species whose life history range currently crosses FMZ boundaries. Aquatic ecosystem functioning and habitat protection are issues and management challenges in every FMZ plan so far. This will help to develop management actions to support specific objectives (e.g., support stratified monitoring, data analysis, reporting). AEC would assist in defining zones or boundaries for managing fisheries. An AEC would help guide monitoring and reporting of sport fish status across Ontario.

Watershed-based Fisheries Management Planning Guidelines (WFiMPGs)
An AEC provides context for planning CFSA, ESA, NHRM, and any and all fisheries management policies and documents, invasive species, Renewable Energy (water) planning and monitoring, etc.

Fisheries Act (FA): We have 3 primary areas of responsibilities under the act: fish passage, prevention of deposition of deleterious substances, and preventing habitat alteration, disruption or destruction. An aquatic ecosystem classification system would help us when we are asked to review development proposals. AEC would also help to develop mitigation measures and possibly compensation plans. An AEC will be integral to the review and development of fisheries policies for

protected areas. With respect to the FA, AEC will allow the strategic identification of available or candidate ecosites for compensatory or comparative purposes - for discussions and strategic planning, cumulative effects assessments, perspective setting, and identifying critical areas for harmful alteration, disruption or destruction (HADD) protection.

Fish and Wildlife Conservation Act (FWCA): Modelling of potential critical habitat may help to identify areas for protection (e.g., spawning areas, brook trout streams, presence of sturgeon). AEC helps to guide sustainable allocation and harvest discussions.

Joint Strategic Plan for Great Lakes Fisheries Management (JSP):
Binational fish community objectives. A variety of GL aquatic classification systems have been drafted and put forward over the years. If an Ontario developed AEC were compatible with, or complementary to, similar efforts by GLFC-Lake Erie Committee member agencies, it would help to satisfy plan-identified needs that including the lake-wide standardization of data collection, interpretation and modelling toward achievement of Lake Eries Fish Community Goals and Objectives via Lake Erie's Environmental Objectives. Monitoring, Assessing, partitioning, protecting and distributing the resource would all benefit from being able to do so based on ecologically classified units. This would help the OMNR to contribute to the JSP's commitment to managing with an ecosystem perspective and may further inform definitions of stocks. GL Fish Community Objectives - Would help to achieve various species mgmt objectives and broad diversity objectives especially in rivers and streams entering the great lakes system. It would allow for identification of unique eco-region specific management (planning, implementation, state of the resource reporting)

Lakes and Rivers Improvement Act (LRIA): Ecological classification boundaries may help to further justify the removal of barriers that currently fragment ecosystem classes. LRIA - strategically identify available or candidate ecosites for compensatory or comparative purposes - for discussions and strategic planning, cumulative effects assessments perspective setting; inform water power project planning, field work and potential mitigation and monitoring, and support LRIA and ESA reviews by identifying locations of aquatic species and habitats.

Endangered Species Act (ESA): may allow us to better predict where aquatic SAR may occur and target these areas for inventory and monitoring; - may improve understanding of processes acting on SAR and improve ability to protect key habitat features, including assisting with options for Overall Benefit actions for 17(2)(c) permits; - inventory (using standard methods) will provide clearer understanding of species distributions and absence data collected through such standardized inventory work would also be valuable. identifying habitat and species occurrence for protection. (ie sturgeon). ESA - ensuring protection of aquatic SAR+ preventing accidental contravention of ESA. would help define distribution and habitat; important in regard to landscape planning especially in urban/agricultural areas of southern Ontario; assist in strategic planning for hydro development; help in modelling (predicting) rates of spread and occurrence of aquatic invasive species; aid in protection of critical habitat and identification of unique areas for protection (Ontario's Biodiversity Strategy; assist in designing sampling strategies for SAR.

Appendix 3: Strategic directions, legislation and policy documents supported by an AEC

Provincial Parks and Conservation Reserves Act (PPCRA), 2006: One of the purposes of the Act is to protect ecosystems representative of Ontario's biodiversity. An Aquatic Ecosystem Classification

(AEC) would aid in the development of a framework for assessing representation of aquatic ecosystems in the provincial protected areas system, gaps in protection and targets for securement. Without an AEC, there is limited ability to assess how the purpose of the Act is being met with respect to protection of aquatic ecosystems in parks and conservation reserves, as well as how specific park class objectives are being achieved. An AEC would also be useful for rationalizing the boundaries of protected areas and to inform management and restoration strategies at different scales. The PPCRA includes the creation of an aquatic class of parks which is yet to be proclaimed in the PPRCA. An AEC would assist with developing and implementing a policy framework for this new park class. PPCRA, PAPM: values collection, gap tool development/representation assessment, support for policy development and regulation of yet to be proclaimed aquatic classification park category as per PPCRA (Section 8(8), long term custodial management of aquatic resources within all categories of protected areas where aquatic values are found (e. g. conservation reserves). PPCRA - meeting Ecological Integrity objectives.
Understanding how well aquatic systems are protected by existing protected areas and identifying gaps in aquatic systems that are in need of protection.

Provincial Policy Statement, 2005 (PPS, 2005, Identification of natural heritage areas, Significant Wildlife habitat component of the PPS); Planning Act (PA)
Resource management and land use activities with the potential to affect protected areas. There are many policies that guide resource management and land use planning in the intervening landscape that have the potential to affect protected areas. Examples of activities include renewable energy (e.g., Natural Heritage Assessment Guide for Renewable Energy Projects, Waterpower Class EA), forest management (forest management planning manual and guidelines), municipal planning (PPS, Natural Heritage Resource Manual, Official Plans), development of transmission corridors and roads, etc. An AEC would assist the protected areas program in providing input to these policies and processes so that negative impacts on aquatic features, functions, values and ecological integrity are addressed and mitigated when there is a project near or within a park or conservation reserve. AEC supports development of ecologically based natural heritage systems design and planning. AEC and the aquatic inventory would be useful as a tool to policy makers and practitioners because it would provide easy and quick OPEN access to information about habitat and biodiversity. Policy makers could identify areas sensitive to development in policy and practitioners would use the information while reviewing planning proposals and providing approvals including assisting MOE in reviewing water taking proposals.

Public Lands Act (PLA) - Useful in assessing impacts of a proposed improvement or land disposition. Identification of natural heritage systems as specified in the Provincial Policy Statement; An AEC would provide a framework for assessing representation of aquatic systems in protected areas networks. An AEC might help identify types of aquatic habitat that would merit designation as provincially-significant.

ANSI Policy: The identification and protection of Areas of Natural and Scientific Interest (ANSI) is based on landscapes or features which have values related to protection, natural heritage

appreciation, scientific study or education. ANSI's are selected based on five science criteria representation, condition, ecological functions, diversity and special features. An AEC is equally important for the ANSI program as for the protected areas system in the development of a framework for assessing representation of aquatic ecosystems. The AEC would be used as a tool to identify these values for aquatic environments associated with ANSIs or to identify new ANSIs according to aquatic features. Valleylands and other significant aquatic habitats outside of ANSIs also need protection on the municipal level and an AEC would enable MNR to better identify the aquatic values in these systems.

Class Environmental Assessment for Provincial Parks and Conservation Reserves (Class EA-PPCR)
Class Environmental Assessment for Provincial Parks and Conservation Reserves is used to assess the impact of projects that occur in provincial parks and conservation reserves. An AEC would be used during the screening process to assess screening criteria such as fish or other aquatic species, communities or their habitat and natural heritage features and areas (e.g., ANSIs, provincially significant wetlands). The AEC would also be used in the project evaluation process to identify significant aquatic features (e.g., best/largest examples of different ecosystems, rare or unique elements) that will need special consideration for impact assessment, mitigation and post-construction effects monitoring.

Protected Areas Planning Manual (PAPM): The compilation and analysis of values and pressures is a key component of the protected areas planning process. The AEC would be a useful tool in identifying these values. Data from the AEC would be inserted directly into the analysis alongside the ELC data to give a comprehensive account of the values found within the protected area and the pressures affecting them. The AEC can also be used for zoning within a protected area. For example, the AEC can identify a value or feature which needs protection from public use. PPCRA, PAPM: values collection, gap tool development/representation assessment, support for policy development and regulation of yet to be proclaimed aquatic classification park category as per PPCRA (Section 8(8), long term custodial management of aquatic resources within all categories of protected areas where aquatic values are found (e. g. conservation reserves). Natural Heritage Reference Manual; An AEC would provide a framework for assessing representation of aquatic systems in protected areas networks.

Planning and Management Policies 1992 Update (PMP, Blue Book): The Blue Book is used to guide the management of the parks system. The blue book describes the guiding principles of park management including representation. The blue book also describes each of the classes of parks and park management policies. The AEC will become useful when these policies are updated and to develop a policy framework for the new aquatic class of parks. The AEC will also enhance our ability to identify and achieve representation targets in the system of protected areas.

Green Energy Act (GEA): Other guidance for resource management planning and impact assessment (e.g., Natural Heritage Assessment Guide for Renewable Energy Projects, Ontario Waterpower Class EA, Forest Management Planning Guidelines). Class Environmental Assessment for Waterpower (MOE's Environmental Assessment Act); Site Release policy for Waterpower. inform water power project planning, field work and potential mitigation and monitoring, and

support LRIA and ESA reviews by identifying locations of aquatic species and habitats. Renewable Energy - River hydrology, flows, habitat to assess impacts of hyrdo-electric proposals. Assist in strategic planning for hydro development; assist in developing consistent scientific principles and guidelines regarding development and operation of existing and new hydro facilities; a tool that can be used to inform policy and legislation regarding hydro development; a tool that can be used for strategic de-comissioning of dams in southern Ontario.

Future Policies: Cumulative effects assessment (CEA)- MNR is expected to develop new guidance on cumulative effects assessment. An AEC would assist with implementing CEA by providing a basis for investigating the effects of human activities on elements of aquatic biodiversity over different temporal and spatial scales.

Crown Forest Sustainability Act - Forest Management Planning (CFSA) - [forest stream networks] risk assessment for roads planning portion of FMP's; Values collection, a new AEC system could possibly be used in the Provincial Stand and Site Guide for identifying aquatic values. CFSA - improved forest management planning (road placement etc). Cumulative effects of watercrossings on watersheds function.

Ontario Water Resources Act (OWRA): input into water take permitting

Strategic Policy Review for Renewable Energy Development on Crown land: Strategic Policy Review: direction not yet determined, but may inform potential strategic planning for waterpower projects. assist in strategic planning for hydro development;

Canada Ontario Agreement (COA): Several components of the Great Lakes Water Quality Agreement, Great Lakes Charter and Agreement and various other Boundary Waters Treaty related works. GLWPS may assist Integration Branch in creation of policy. MNR delivers the Surface Water Monitoring program and supports water budgeting (source water protection) as well as maintains the Water Resource Inventory Program. AEC could be integrated or directly linked to a WRIP based IM system linking quantity to your other measures. You need to work with SIRD to develop the AEC system please. 3) GLWPS administers the Canada Ontario Agreement. Many of its projects are based in tributaries and focused on restoring habitat, species and improving the quality of the Great Lakes. the AEC could be useful in identifying priority areas for projects, species restoration and prioritizing projects for funding.

Niagara Escarpment Plan; Niagara Escarpment Planning and Development Act (NEP, NEPD): The purpose of the NEPDA is to provide for the maintenance of the Niagara Escarpment and land in its vicinity substantially as a continuous natural environment, and to ensure only such development occurs as is compatible with that natural environment. The AEC could contribute to features and systems based planning and contribute to assessments of sustainability and compatibility. The Niagara Escarpment Plan requires considerations of cumulative effects and water resources (quantity, quality, wetlands and fisheries) as well as environmental monitoring requirements which would be enhanced by AEC.

Appendix 3: Strategic directions, legislation and policy documents supported by an AEC

Emergency Management and Protection Act (EMPA) and Ontario Low Water Program (OLWP), Flood Forecasting: Water quantity and water resource management are concerns. A classification would allow us to establish sensitive and prone areas to floods and drought, to better manage water resources. Establishing priority water use during drought is an example of how we can make use of this classification. Knowledge about the state of rivers and streams (physical parameters) would also help in decision making.

Lakewide management planning (LaMP's): It would allow for identification of unique eco-region specific management (planning, implementation, state of the resource reporting)

Far North Land Use Strategy (FNA, FNLUS): Far North - Understanding the distribution of species and providing insight into the productive of AE in the far north. This information will be invaluable as we continue to develop and use resources in the Far North.

Mining Act (MA): An AEC would be useful for Far North community-based, watershed-wide planning

Environmental Assessment Act (EAA): An AEC would be useful for Far North community-based, watershed-wide planning

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